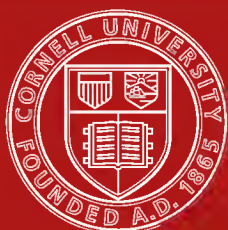


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FURTHER REPORT

ON THE

BORE OF THE TSIEN-TANG-KIANG.

BY

CAPTAIN W. U. MOORE, R.N., H.M.S. "PENGUIN."

1892.

PUBLISHED BY ORDER OF THE LORDS COMMISSIONERS OF THE ADMIRALTY.

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Further report on the bore of the Tsi-



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CHINA.

REPORT ON THE BORE OF THE TSIEN-TANG-KIANG.

H.M.S. "Penguin,"

CHINHAI,

15th November 1892.

SIR,

When making my report to you in 1888 on the Bore of the Tsien-tang-kiang, it was a matter of regret to me that I had no photos to attach; and on my return to the north of China I determined, if possible, to procure a photographer to accompany me to Haining to obtain pictures of the phenomenon at the time of full moon following Autumnal Equinox. When we arrived in Shanghai in September, Mr. E. Q. Cooper, a chemist, of the firm of Messrs. Watson & Co., agreed to go. I asked Mr. Walker, Chief Engineer, to accompany me, and we started on the 2nd October, intending to photograph the Bores of October full moon in Perigee and three succeeding days.

Full moon at 2h. 14m., October 6th.

Perigee at 1h. 0m., October 7th.

Declination of moon at full, $5^{\circ} 38' N.$, increasing.

Declination of sun, $5^{\circ} 26' S.$, increasing.

Latitude place, $30^{\circ} 24' N.$

Mr. Cooper took with him a large camera with $10'' \times 8''$ plates. I had a half plate camera. Mr. Walker agreed to observe the phases of the Bore from the pagoda. We arrived at Haining on the afternoon of the 5th.

Unfortunately we only enjoyed one sunny day, the 6th. On the 7th, 8th, 9th and 10th, the sun was behind clouds. On the 7th and 8th it rained slightly at intervals. This gloomy weather has, to a certain extent spoilt the photos as pictures; but for purposes of discussion as to form, height, &c., they seem to be good enough.

It is not easy to photograph a Bore. In the first place there is the difficulty of focus. No boat, of course, is in the river for 5 hours before the flood comes in; and, in fine weather, there is not sufficient

ripple to make a definition clear enough for the purpose. Then, whatever place is selected, it must not be less than 14 feet above the low line of the river, and somewhere at the side. The speed at which the flood approaches is so great (20 feet a second) that the exposure must be limited to a fraction of a second. See this impression of a half plate, which I exposed by cap for one second.

If the sun is obscured, as it generally was with us at the time the Bore passed, this great speed gives the photographer a poor chance. Finally, no photo, which gives a distinct view of the front of the Bore within 500 yards, comprises more than a portion of its breadth; and as the camera is, necessarily, much nearer one side, the highest part of the cascade, which is 350 yards from the Haining shore and retarded, is not shown to advantage in perspective.

We found that the buttress west of the pagoda had been backed up on its western side by a massive stone wall, the top of which was 15 feet above low water. Mr. Cooper established himself on the edge of this wall, at a distance of 50 yards from the western fascines of the buttress, and 80 to 90 yards from the spot where the left or northern edge of the cascade comes round the buttress. From this position he observed the Bore every day; and on the 7th, 8th, 9th and 10th he managed to take it when its foot reached identically the same spot. On the 6th (the only day he had the sun), he took it when it was some 200 yards east of the buttress. The picture then obtained, though of no use for purposes of comparison with those of the succeeding days, gives a good general idea of an average Bore on the day of full moon; and it comprises a greater breadth than those taken nearer, possibly it takes in as much as one-third of the whole line of cascade.

The buttress is 27 feet above low water. People standing near the edge, but not actually on the parapet would be, say, 31 feet above low water. The distance from the camera to the south or right edge of the photograph was from 400 to 450 yards. Only 350 yards of the cascade is included in the picture, but we think that the highest part of the cascade just comes in.

My photographs, with half plate camera, were taken from various buttresses. On the 6th I was on the second buttress west of Haining, about one mile from the pagoda and 28 feet above the river; on the 7th and 8th, on the first buttress west of the pagoda (that which is in Mr. Cooper's picture), 31 feet above the river; and, on the 9th and

10th on the buttress 500 yards east of the pagoda, 28 feet above the river.

The principal results obtained by the the photos are the exhibition of the extreme regularity of the daily form of the bore*, the convexity of the flood, and a better idea of height than can be suggested by any descriptions.

The weather during our stay at Haining was very much the same throughout, the river being undisturbed. On the 8th, 9th and 10th strong N.E. winds prevailed in the Chusan Archipelago (P. & O. S.S. "Bokhara" left on 8th), but in the river the winds were light from north, and the water smooth.

As regards the main features of the phenomenon, I have very little to add to my report of 1888. The Bore which we considered the highest was on the 9th, and attained an altitude over the deepest part of the river channel of 12 feet. This was a somewhat remarkable Bore. About $1\frac{3}{4}$ million of tons of water passed in one minute. Directly the cascade had passed, Mr. Cooper reversed his slide and took the buttress again (he tells me in less than a minute from the first photo). Please notice the very small space between the top of the cascade on the right of the picture, and the horizon. I should say about one-fourth the height of the cascade. Again, take the difference of height of water at the buttress before and after the Bore, remembering that the latter photo was taken long before the flood had lost its convexity; or take the height of the man, divide him by $5 \frac{400 \text{ yards}}{80 \text{ yards}}$ and compare this dividend with the right part of the cascade. I think you will allow that 12 feet is not too great an assessment for height. The camera was 19 feet high.

The statement made to me by the Haining people in 1888 that the highest tides reached to within 2 feet of the top of the sea wall abreast the pagoda, (page 26, Report) was corroborated on this visit. On the 8th, high water was 1 foot 6 inches from the top of the wall, *i.e.*, a range of 22 feet for the day, the Bore being 11 feet high; and on the 9th, the water was only 6 inches lower.

On the 8th, Chinese 18th day of the 8th Moon, the Tao tai of Hang Chan, and some 5,000 to 6,000 people assembled on the wall to

*Only two of the series of photographs are reproduced with this print of the report. These two have been selected as giving the best general idea of the bore, and are placed at the end.

witness the passage of the Bore, and propitiate the God of the waters by throwing in offerings on to the flood. On this, and the following day, the rebound from the sea wall, and sudden heaping up of the waters as the flood conformed to the narrow mouth of the river, here barely one mile wide at low water, was a magnificent spectacle. A series of breakers were formed on the back of the advancing flood, which, for over 5 minutes, were not less than 25 feet above the level of the river in front of the Bore. The height of my eye was, on the 8th, 31 feet; on the 9th, 28 feet; and the top of these rollers were much higher than the horizon for some time: the distance of the cascade being in the first instance about 2 miles, in the second about $1\frac{1}{2}$ miles from my place of observation.

There is no doubt that the flood has a convex transverse surface on entering the river, and it did not appear to me to flatten out to the side for a long time after the Bore passed. This convexity, which occurs partly from the heaping up of the waters in the middle on entering the mouth of the river from the broader estuary, and partly from the ever-recurring deflection caused by the numerous buttresses, is noticeable in photos 4, 6, 11 on the sheet of smaller photos; but as the highest portion is retarded and consequently further from the camera, it is not always so conspicuous in photos as you might expect from the report.

On the 9th, no less than 30 junks were swept up in the after-rush, and passed Haining with all sail set, but their bows in every direction, several proceeding stern first at a rate of 10 knots towards the City of Hang chau.

All these Perigee Bores were before their time, as might be expected; and they were travelling faster than usual. That of the 10th was $1\frac{1}{2}$ hours early, and travelling at the rate of 14 knots an hour. The night Bores of the 6th, 7th and 8th were distinctly heard $1\frac{1}{2}$ hours before they arrived, when they must have been at least 12 miles distant.

By this mail, I am sending, by parcels post, a hinged box with some photos, which I hope you will accept. As a picture, you will probably consider the large one of the 10th the best. Mr. Cooper exposed for one-fiftieth of a second. Had the sun been out, he would have succeeded in producing a beautiful picture. On the 9th, the sun was out, and actually shining on the part of the Bore not in the field of the lens, which was most exasperating. On the 10th I got a profile

view of the cascade (the last photo on the right hand lower corner of the card with the series) just as it passed me at the east buttress, $2\frac{1}{2}$ minutes before it came to Mr. Cooper, which gives a notion of the flood fighting its way against the river stream. As I have before remarked, all the photos are from too high a position to do justice to the scene.

Attached is a list and description of the photos on the second card.

I have the honour to be,

Sir,

Your obedient Servant,

W. USBORNE MOORE,

Captain.

Captain W. J. L. WHARTON, R.N., F.R.S.,

Hydrographer.

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1893.



BORE OF THE 10TH OCTOBER 1892.
DISTANT 100 YARDS.



BORE OF THE 6TH OCTOBER 1892.
DISTANT $\frac{3}{4}$ OF A MILE.

